UNIVERSITY OF PENNSYLVANIA

CLINICAL STUDIES OF FAILURES WITH THE WITMER FORMBOARD

BY
ADAM PERRY KEPHART

A THESIS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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CLINICAL STUDIES OF FAILURES WITH THE WITMER FORMBOARD.[1]

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Introduction.

In 1915–16 H. H. Young[1] made the first extensive study with the Witmer Formboard and used the results from testing 1474 normal boys and 1375 normal girls of all ages for a preliminary and basic standardization of normal children.

The object of the following investigation was threefold; (1) to study the formboard as an educational device; (2) to analyze failures so as to determine why a subject fails and what his failure means; and (3) to get one who has failed, to do the test with a minimum amount of teaching.

No attempt was made to examine a large number of children. The investigation was not interested in the standardization of results or in standard procedure, but in learning what difficulties the formboard presents, what causes failure, and what failure means in relation to diagnosis. Wherever children were tested in a school, the request was made that the worst in the room be sent. That is, failures were not selected from a miscellaneous number who were offered for the test, but were found by examining the youngest and most backward pupils in the lowest grades and kindergarten of two public schools and a Montessori school, and the most apparently backward children who could be found about a small social center.

Some children who failed, as well as some very young children, were given instruction. This is reported under each case. In general, failure was determined arbitrarily by the fact that the trial was left as finished when one or more blocks were left unplaced or incorrectly placed, or that the child received some assistance, or more than the standard instructions as given in the method of procedure.

[1] Reprinted from The Psychological Clinic, Vol. XI, No. 8, January, 1918.

Method of Procedure.

In the initial presentation of the formboard to all the children but case 1, the standard method of procedure of Young[1] was followed exactly except in two points: (1) the subjects were selected; (2) they were not required to stand. The different places in which they were found made it necessary to use the tables and chairs that could be obtained. In every case, however, the child was seated so that he could reach the blocks without strain or distraction. The light was always the best obtainable. In the case of successes, Young's standard method was not departed from except in the two points mentioned. All three trials were given and the standard data collected, with such additions as will be described under the head of "data collected." In the case of failure, the method was varied to suit the age or to meet the difficulty encountered. The amount and kind of assistance and instruction given were standardized and graduated. In some cases very little was given. In a few cases so much help was given that it amounted to showing the subject exactly what to do. The attempt to do exactly the same thing for every child was for the purpose of making the results comparable. However, in very few cases were two or more children given exactly the same amount of instruction. The lists given below consist of the instruction given, from the minimum amount, up to the actual placing of the blocks for the child.

The board was laid before the child with all the blocks correctly placed, and the child was allowed to see the examiner take them out and put them in the tray. The following steps were taken as needed, but only as much as needed. In case what was said or done did not have any effect the next step was taken.

1. "Go ahead, or "All right," or "Ready."

2. The original instructions were repeated or the examiner simply said, "See how quickly (or fast) you can put them back."

3. If the child picked up a block and began,—tried to place it, he was allowed to work until he gave up.

4. If the child did not begin after the repetition of the instructions and sufficient urging and encouragement, the following procedure was followed, using only as much of it as was absolutely necessary, under the condition that the minimum amount of instruction should be given.

(*a*) Examiner picked up block 6 and handed it to the child.

(*b*) Examiner said, "Place it," or "Put it back."

(*c*) If the subject tried to place the block and persisted without success indefinitely (beyond ten minutes) and the quality of the

performance warranted it, the examiner interfered and the next step was taken.

(*d*) If the child threw the blocks away or put one in his mouth, it was handed to him until it was clearly seen that he would go no further; or if he simply quit and refused, the examiner took the block, pointed to the recess and handed the block back to the subject. This was usually enough. In the case of a few babies and one or two others it was necessary to do this.

(*e*) If the blocks were placed in a random fashion over the face of the board, the trial was called a failure and the teaching began as described in the preceding paragraph. If showing how to place block 6 was not sufficient, after the examiner was sure the subject could place that one, he added 1 and taught the two until there was no doubt about the ability to place them. Then 2 was added, then 4, then 3 and 8 were taught in a similar way; then 7 and 9, 10 and 11; thus taking the two or three that were confused and teaching them together until there was certainty in placing.

(*f*) If after correctly placing one or more blocks the child refused to go on, he was urged by saying, "Go on, finish it," or "Put the rest back."

(*g*) If he had trouble with any one block, he was allowed to work as long as he would, until it could be called an actual failure.

(*h*) If he failed and gave up on any block, the trial was counted a failure. The examiner then corrected all the errors and without comment started the next trial.

(*i*) If on the third trial the child could not place one or more blocks correctly, the examiner said either, "Look at it carefully," or "Turn it around." If this had no affect the examiner took the particular block and turned it and then handed it back. If it was not placed the examiner took the block and placed it, then handed it back and said, "Now you put it in."

(*j*) If the child, on the third trial, persisted in trying to place the block in one place without looking around the examiner said, "Look all around."

There are other details of teaching which were used with individual cases, and described in the case reports. The general method, so far as it can be made standard, was as described.

Data Collected.

As far as possible the following record was made: Name, sex, chronological age, school age, teacher's estimate, whether failure or not, diagnosis, rating on five point scale, formboard time, nationality, social class, physical characteristics, and qualitative statement.

In case of failure, further clinical examination was made using one or more of the following tests: peg-board, color discrimination, design blocks, Witmer cylinders, hearing, vision, memory span, Healy completion test, Binet (Terman) scale, reading, writing, number work. The data collected from these tests was used in making the diagnosis and summation rating.

Reports of Cases.

As far as possible all of the cases are treated alike, especially in the order of presentation of the material. Case 1 is an exception to this, as the study was made as a separate investigation, as noted in the report. In the case of school children the school rating or teacher's estimate was given. By the type of failure is meant the type of performance. When it is recorded that the failure type is one of "imageability" it means that, judging from the performance, the failure is due more to lack of imageability than to any other factor although all the other disabilities may be contributing to the failure. There is no thought or intention of intimating that failure is due to any one lack or disability or that an ability can be isolated in function. In the rating, in the technical diagnosis, every child is compared with others of his own age. The selected cases are reported to illustrate the various types of performance and to bring out the abilities which make success possible and the disabilities which make failure possible.

The two reports selected for presentation are of interest because of the possible comparisons and contrasts. The first is a normal one year old baby and the second a twelve year old idio-imbecile. Both fail for the same reason, and the second is mentally of the same age as the first child when she first succeeded with the formboard. It is unfortunate that neither of these can be located on Young's standardization. The other failures, unless they were below all of Young's, were located thus: shortest of Young's successes, in group IV of 4¾ years; shortest of Young's failures, from group I of 4¼ years to group V of 8¾ years.

Case 1.

Girl. Diagnosis: Normal. Age: 13 mo. School age: 0. Rating: 3.5. Formboard Time: See report. Nationality: American. Social Class: Professional. Physical Characteristics: Normal. Young's Standardization: Shortest of successes: Below all. Shortest of failures: Below all. Types of Failure: Lack of understanding and persistent concentration of attention. Why Selected: To determine how long it would take the baby to teach herself to do the formboard test.

This study was made for the purpose of observing the part played by the several abilities as they develop in the very young child. Margaret had had no experience with the formboard and little experience with other blocks. As will be seen in the description of the method as applied to this case, the minimum amount of instruction was given. For six months the child worked with the test until she was successful. With few exceptions the board was placed before her on a small table and she sat or stood before it. The task could not be given to her daily on account of the occasional absence of the examiner. She was allowed to work or play with the board only under supervision during the first four months of the experiment. During the last two weeks it was placed on a low cabinet where she could have it all the time. No one besides the investigator was allowed to present the test to her, and she was not allowed to see anyone else try it. During the first four months, after each presentation, she was permitted to play with the board as long as she would. Thirty tests were made during the first four months, from May 30th to September 28th. After that she did not see the board for a full month. From November 1st to 12th, when complete success came, she had the board to play with as she pleased, but without assistance and never with other children.

Test 1. May 30, 1915. Age 12 mo. 18 da.

(*a*) Before showing the formboard all the blocks were placed in the tray. It was then put before her and the examiner said, "Put the blocks back." This was repeated twice. She did nothing.

(*b*) The circle was picked from the tray and the examiner said, "Put this one in." She took it, looked it over, and handled it as she would any other article, then put it in her mouth. The examiner insisted, "Put it in." She did not try.

(*c*) The examiner placed the circle in its recess, handed it to her and said, "Margaret do it." She took the block and put it in her mouth.

(*d*) Without permitting her to see what he was doing, the examiner placed all the blocks in their recesses with the exception of the circle. He then put the board before her, handed the circle to her and said, "Margaret, put it in." She took the block but did nothing with it. The examiner then took it, put it in its recess and pointed to it. He then took it out, handed it to her and said, "Margaret do it." *She quickly put it in.*

(*e*) With all the blocks in their recesses the examiner took the circle, placed it on the board just beside the recess and pushed it in.

He then placed it again in the same position and said, "Margaret, do it." *She quickly did it.*

(*f*) The examiner placed all the blocks in the tray. Margaret picked up the circle and tried it in the diamond recess. She then lost interest and tried to take the examiner's pencil and paper. She threw the blocks around the room.

The circle was chosen because it is the simplest of the forms. It requires less information, less coördination, than any of the rest, and is attractive. In (*a*) above there were several possibilities. She may not have understood what was asked. She most likely did not associate any of the blocks with any of the recesses. In (*b*) she did what she needed to do, took the block and examined it and the mouth was the proper place to put it. She could not associate it with the recess as there is little resemblance at first presentation. In (*c*) one would expect her to follow the lead and at least place the block on the board somewhere. But she still did not have enough information or did not understand what was wanted. There were too many recesses. In (*d*) the number of choices was cut to one but she did not understand the command. When the examiner placed the block for her the command was explained and interpreted and she quickly responded. Trial (*e*) was not necessary but it served as a review of the fact that the block and the recess belonged together. Trial (*f*) showed that she had reached the limit of persistence of attention.

The coördination of hand and eye movements is most important in this early feat of coördination. An occasional glance might be sufficient to locate and associate the block and its recess, but the hand movement would have to be fairly precise to bring success. The performance shows that the command and the demonstration were necessary because of the small range of observation and distribution of attention. Attention is forced by the procedure but the period is very short. The first test did not last longer than three minutes.

Test 2. May 31, 1915. Age 12 mo. 19 da.

(*a*) With all the blocks in the trough, the board was placed before Margaret with the command, "Put the blocks all back." She pulled at the board and picked up blocks at random, but always picked up the circle first.

(*b*) The examiner picked the circle from the tray, handed it to her and said, "Put this one in." She took it and looked at it as she turned it over and over.

(*c*) The examiner then took the circle and said, "See Daddy do

it," and placed it. He then handed it to her and said, "Margaret do it." She quickly placed it.

(*d*) With all the recesses filled except 6, the board was put before her. The circle was given her with the command, "Margaret put it in." She did it.

(*e*) With all the other blocks in their recesses, the circle was placed beside its recess and the command given, "Push it in." She did it.

Very definite progress is seen in this second presentation. The amount of teaching is cut down. A decided improvement in analytic concentration of attention in a very elementary form is shown by the very certain success when the number of choices is increased.

Test 3. June 1, 1915. Age 12 mo. 20 da.

(*a, c, d*) Procedure and result the same as on the first two days.

(*b*) The examiner took the block from the tray (all recesses being empty) and handed it to her saying, "Margaret put it in." She placed it with very little hesitation and without trial and error. She then took the cross and tried to put it in the circular recess.

Here is shown another definite stage of improvement. She selected the proper recess from many empty ones. The simplicity of the task and the first attempt to place another block are to be noted.

Test 4. June 2, 1915. Age 12 mo. 21 da.

There was no variation from the third day except that she tried to put the circle in a triangular recess.

Test 5. June 3, 1915. Age 19 mo. 22 da.

Could not get any response.

Test 6. June 4, 1915. Age 12 mo. 23 da.

(*a, b, c*) Procedure and success as before. She tried to put the circle in the semicircular recess and in several other places, and then lost interest.

(*e*) She picked up the circle and rolled it across the floor. She then tried to put it in the recesses for cross, triangle, and star; took the diamond and star, put them on the floor, and then walked away with the circle.

In (*a*) the attempt to put the circle in other recesses and in (*b*) her attention to other blocks were significant in that she was showing interest in other blocks and that her distribution of attention

was increasing. The repeated success of (*b*) shows that the success was not accidental.

Test 7. June 9, 1915. Age 12 mo. 28 da.

(*a*) The examiner put all the blocks in the tray and told her to put them back. She picked the circle and placed it without trial and error.

(*b, d*) Procedure and success as before. She then took out a few blocks, emptied the board, and carried the semicircle away.

This was the first time she took a block from the tray and placed it; it was also the first time she tried to take the blocks out of the recesses, showing that she had some idea of the relations.

Test 8. June 14, 1915. Age 13mo. 3 da.

(*a*) Procedure and success as on the 9th. She tried the ellipse in the square and circular recesses and then in its own recess.

The other trials were omitted. On the 9th she seemed to see some of the relations and now she applied this knowledge in correctly placing the ellipse after two trial errors. There was little analysis yet, but still it was not entirely trial and error, unless the success on the third trial was accidental. The procedure was largely confined to offering her the board with all the blocks in the tray.

Test 9. June 15, 1915. Age 13 mo. 4 da.

(*a*) Procedure and success as before.

(*c*) The examiner handed each of the blocks to her in succession. She threw them down at once with the exception of the circle. She held it and looked at it for about five seconds and then placed it correctly.

Test 10. June 16, 1915. Age 13 mo. 5 da.

(*a*) Procedure and success as before, three times in succession. She tried to put the circle in the semi-circular recess but then went to playing and throwing the blocks about.

Test 11. June 18, 1915. Age 13 mo. 7 da.

(*a*) She took the circle from the tray and placed it correctly.

(*b*) The examiner put the circle back in the tray with the other blocks, then took it out, handed it to her and said, "Put it back." She did it.

(*c*) The examiner placed all the blocks in the recesses without

permitting her to see the operation, handed her the circle and said, "Put it back." She did it.

(*d*) The examiner repeated trial (*a*). She played a while and lost interest.

Test 12. June 20, 1915. Age 13 mo. 9 da.

No apparent progress except that she took all the blocks out and placed them beside her on the chair.

Test 13. June 21, 1915. Age 13 mo. 10 da.

No progress. The time was spent playing with the blocks.

Test 14. July 1, 1915. Age 13 mo. 20 da.

(*a*) With all the blocks in the tray she picked out and placed the circle, then passed out the blocks to the examiner, one by one, threw them around the room and tried to put the circle in the square and elliptical recesses. When other blocks were handed to her she threw them away.

Test 15. July 4, 1915. Age 13 mo. 24 da.

No new developments. Trial (*a*) only was given.

Test 16. July 10, 1915. Age 13 mo. 29 da.

(*a*) With the board empty she took first the circle and then the star and placed them correctly without trial error. She then wanted to throw the blocks. She sat on the board, turned it over and tried to place the blocks on the under side.

Here we see another definite acquisition. Of her own accord she picked the star, an attractive form, and placed it correctly. That she tried to place the blocks on the under side of the board indicates improvement in understanding.

Test 17. July 15, 1915. Age 14 mo. 3 da.

Performance of the tenth repeated exactly.

Test 18. July 28, 1915. Age 14 mo. 16 da.

(*a*) With all the blocks in the tray she took the circle and placed it. She then tried it in other recesses, took it out and put it back four times in succession. She tried the star in its recess but could not make it go down. She then took the other blocks from the tray and passed them to the examiner one by one and sat on the board.

Test 19. July 30, 1915. Age 14 mo. 18 da.

(*a*) She took the circle from the tray, tried it in the semicircular and square recesses, then on the cross and then in its own recess.

Test 20. August 2, 1915. Age 14 mo. 21 da.

(*a*) She took the hexagon (10) and tried it in the diamond (11) recess, the semicircle (5) in the ellipse (4). She then put the ellipse on the hexagon and tried to put both in the diamond recess.

(*b*) Without permitting her to observe, the examiner put all the blocks in their recesses, handed the star to her and said, "Put it back." She placed it without error after a little fumbling.

Test 21. August 10, 1915. Age 14 mo. 29 da.

This test was a complete failure. She showed no inclination to try.

Test 22. August 11, 1915. Age 14 mo. 30 da.

The examiner presented the board with all the blocks in their recesses. She took out all and then put the equilateral triangle (9) back in its recess. She then tried to put the cross in the circular recess and the circle in the cross recess but lost interest and quit.

Test 23. August 13, 1915. Age 15 mo. 1 da.

When all of the blocks were in the tray the examiner handed the circle to her and she placed it correctly. He then gave her the star and she put it on its recess but not down in it.

Test 24. August 20, 1915. Age 15 mo. 8 da.

With all the blocks in the tray she took the circle, placed it, took it out again, and tried to put the star in the circular recess. She then took the cross and tried it in the circular recess, and then put the circle back in its recess.

Test 25. August 24, 1915. Age 15 mo. 12 da.

No progress or change to report.

Test 26. August 25, 1915. Age 15 mo. 13 da.

(*a*) She took the circle and placed it, tried it in the recesses for semicircle, ellipse, cross, and star, then put it back in its own recess. She took the semicircle and star and put them on but not down in their own recesses.

(*b*) With all the blocks but the star and semicircle placed, the examiner gave her first the star and then the semicircle saying, "Put this one back." She refused and ran away.

In these recent tests she seemed to think that if the circle would fit one recess it should fit all, so she tried it around the board. This shows poor imageability, but increased association and understanding. On the second of August there was indication that she was beginning to think of the other blocks in the same way that she did of the circle. There was indication of an attempt to use the trial and error method in working with other blocks than the circle. On the second she placed the star, and on the eleventh the triangle. She now reversed the association and tried the other blocks in the circular recess. On the thirteenth and twenty-fifth, she definitely connected the star and semicircle with their recesses.

Test 27. September 7, 1915. Age 15 mo. 26 da.

With all the blocks in the tray she took the cross, semicircle, and circle and tried to place them but failed. This is the first time it was certain that she understood when told to take the blocks out and put them back, for she repeated the effort when told to do so. In taking them out she took them one by one from the board to her chair, and when only three were left she turned the board over. When she was told to put the blocks back she tried a few but lost interest and quit.

Here is shown definite interest, increase in understanding, increase in distribution of attention, and increased persistence of attention.

Test 28. September 17, 1915. Age 16 mo. 5 da.

The examiner placed the board before her with all the recesses filled and said, "Take the blocks out and put them here" (indicating the tray). She put them all there except the cross and the rectangle. The examiner then said, "Put them back." She began picking up the blocks, placed the circle and cross, and quit.

Test 29. September 26, 1915. Age 16 mo. 14 da.

The examiner placed the board before her as on the 17th. She took all the blocks out and placed them in the tray. He then told her to put them back. She put all on the board but only the circle in its recess. She worked longer than at any previous test and seemed to like to take the blocks out and put them back on the board.

Test 30. September 28, 1915. Age 16 mo. 16 da.

With all the blocks in the tray the examiner gave her the circle and she placed it. He then took away the circle and gave her the cross. She tried to force it into the circular recess. The examiner then put the circle in its recess and gave her the cross. She took the circle out and again tried to force the cross into the circular recess. She then took the semicircle, star, and cross and tried all in the circular recess.

The results so far are about what would be obtained from a low grade imbecile on the first trial with the formboard. There is about the same amount of interest, persistence, and imageability. This is the first time Margaret took all the blocks out and placed them all back on the board. This certainly shows increase in understanding and in persistent concentration of attention.

Test 31. November 12, 1915. Age 18 mo.

During the day it was observed that Margaret had put all the blocks back in the correct recesses. It was known that they had been scattered about the room before and that no one else had replaced them. The examiner immediately placed all the blocks in the tray, put the board before Margaret and said, "Margaret, put them all back." She worked for nine minutes with many trial errors, and placed all without final error. During the nine minutes many things distracted her. The coördination was poor, the rate of energy discharge was very slow. Most of the nine minutes were spent in looking about, handling the blocks, shaking them, and jabbering to the examiner, but when she made up her mind to place a block she did it relatively quickly. This same condition persisted throughout the trials which follow. A large part of the time was spent in playing. From this time on many unrecorded tests were made.

On December 25th all were placed in three minutes, on April 24th, after she had not seen the board for five weeks, they were all placed with one trial error in 110 sec. On August 10th the time was 70 sec., on November 10th three times in succession it was 45 sec., and on January 15, 1917, when she was aged 32 months, it was 35 sec. Since then the time has not been improved and there is no attempt to speed up. From the first success, most of the time was spent in playing between placing the blocks.

CASE 15.

Girl. Diagnosis: Idio-imbecile. Formboard Time: F. 196—F. 436. Age: 12 yrs. 4 mo. School Age: Kindergarten. Rating: 1.2.

Nationality: Italian. Social Class: Poor shopkeeper. Physical Characteristics: Cephalic index, 79.03; head girth, 52.9. Talks little more than a child of two. Hard palate high; protruding canines and wide frog mouth; leering, wolfish appearance, slant eyes, and nystagmus in both; extreme knock knees, spraddle legs and feet, small ears, and awkward, babyish gait. Very thin. Young's Standard: Shortest of successes: below all. Shortest of failures: below all. Type of Failure: Lack of understanding and persistent concentration of attention.

TESTS.

Formboard.

I. Blocks were fingered in monkey fashion. After the directions were repeated she placed 3, 6 and 8 and put the rest on top of the board.

II. She again put the blocks on top at random. When 1 was given to her she placed it over recess 2, but corrected it when the examiner said, "No." Nos. 2 and 4 were treated similarly. All of the blocks were then placed with many trial errors, 7 would not have been placed had not an observer said, "She has it backward." Time approximately eight minutes, five spent in placing 7.

III. Repetition of trial II. Time 436 sec.

Further examination had to be made a week later when the formboard was given again.

Formboard (second test).

I. A better performance, but she still persisted in removing correctly placed blocks. She compared the blocks by fitting them together. There was improvement in distribution of attention. No assistance except urging was given. Time 523 sec.

II. Improvement in selecting and rejecting and in memory of the simpler forms but no persistence. Time 116 sec.

III. Only three trial errors, improved interest evidenced by singing and more rapid work. Time 99 sec.

Peg-board.

Random pegging with very poor coördination. Qualitatively a two year old performance. Time 148 sec.

Design Blocks.

Failed on all but a row of red blocks. Could match colors if attention was held.

Witmer Cylinders.

I. Random placing with poor coördination. The examiner placed all but three, one of which she placed correctly. The other two were interchanged. She was then told which were right and she corrected the two. In the same way the four largest were placed with two trial errors, four scattered with no errors, then five with four errors, then five long cylinders with four trial errors, then five long ones with small diameters with two trial errors. All were now taken out and she began again. Her attention wandered. She said "bang" as she placed each one. When told to correct two that were wrong she took them out. The examiner then removed five that were wrong. After very much assistance all were placed in 499 sec.

II. Trial I was repeated. She tried to force large into small, and left small cylinders in large recesses. Occasionally she leaned back and laughed and hit the cylinder a hard blow. Time 452 sec.

Binet (Terman revision).

Mental age score, three years. Intelligence quotient, 24.3.

This girl is obviously an idio-imbecile. She plays about with other children, is imposed upon and cries at nothing, like a two year old child. Her speech is very incoherent. She has been in the kindergarten all her school life and she is improving a little. Her brother of nine years, in the fourth grade, has the appearance of a mongolian and some of the marks of the high grade imbecile. The girl is always dirty, scantily dressed, and exhibits herself anywhere. On the five point scale the following ratings are given: energy 2, rate of energy discharge 2, resistence to fatigue 2, health 2, control 1.5, coördination 1.5, initiative 2, complexity of responsiveness 1.3, vivacity 4, analytic concentration 1.3, persistence 1.5, distribution of attention 1.3, imageability 1.2, understanding 1.3, memory 1.4, and intelligence 1.2. This is a good illustration of the fact that control, coördination, and general vitality may be very low, but may not produce failure without lack in some other respect.

General Analysis.

It will be seen from table III that there is little, if any, relation between age, formboard time, diagnostic rating, and diagnosis (in cases of this investigation) except the direct relation between summation rating and diagnosis. Table II shows the general tendency for time to decrease with age for 188 subjects. A summation of all available cases is not possible on account of the incomplete record of formboard time for the failures who came to the Clinic. Table III is

given to afford a short summary of these studies rather than to attempt to prove anything.

H. H. Young had a total of 182 failures out of 3031 cases examined, or 6 per cent; 75 out of 1549 boys or 4.2 per cent, and 107 out of 1422 girls or 7.2 per cent. Of the 122 failures, 72 per cent occurred on the first trial only, 11 per cent on the first and second trials, 3 per cent on the third trial, and two children failed on all three trials. In this investigation all but one failed on the first trial. In some cases there was only one trial, as the strain of teaching wore the child out. Ten failed on the first trial only, none on the second only, none on the third only, six on both first and second, one on the first and third, and seven on all three trials.

Although this investigation was not undertaken to find the failure level for the formboard, there are many things in the results which make it possible to locate that level approximately. In Young's investigation, in which he tested all children who were sent to him, taking every child in a school room, he found that out of fifty children under five years of age, twenty-four succeeded on the first trial and twenty-six failed. It must be remembered that he set a time limit of three minutes and called all failures who did not succeed in that time. In the present investigation, where the subjects were selected with the purpose of finding failures as soon as possible, of the thirty subjects under five years of age, sixteen failed and fourteen succeeded on the first trial. In Young's investigation, of the one hundred subjects over five years of age but less than six, seventy-eight succeeded on the first trial and only twenty-two failed. In the present investigation, of the twelve subjects over five but less than six, eight succeeded and four failed. These twelve must be remembered also as selected for failure. All of this indicates that the majority of children over five years of age may be expected to succeed with the formboard on the first trial. The fact that the subjects of this investigation were selected simply emphasizes this point, since in spite of the selection, twice as many succeeded in the sixth year.

Of the 1400 cases in the Psychological Clinic of the University of Pennsylvania who were examined with the Witmer formboard since it has been in use, 137 failed on one or more trials. This is roughly 10 per cent. Tables IV and V present an analysis of these failures. Of the eighteen diagnosed as normal, sixteen were under five years of age. Of the one hundred diagnosed as definitely feeble-minded, 69 per cent were *over* five years of age. Young tested very few children under five years of age, the median of his failures coming at 6.75 years. However, 80 per cent of his failures were between

TABLE I.—YOUNG'S SHORTEST TRIALS.

Age	No.	I	II	III	IV	V
4.25	8	34–36	42	50	53	60
4.75	16	22–36	35–37	39–42	43–47	53–103
5.25	34	20–26	27–31	32–36	37–44	46– 67
5.75	44	16–25	26–28	29–32	33–38	39– 92
6.25	101	20–26	27–29	30–32	33–38	39– 76
6.75	106	17–23	24–27	28–31	32–37	39– 86
7.25	145	18–22	23–25	26–28	29–31	32– 56
7.75	143	15–20	21–23	24–26	27–30	31– 51
8.25	145	12–19	20–22	23–24	25–27	28– 42
8.75	140	13–17	18–20	21–22	23–25	26– 38
9.25	138	12–17	18–19	20–21	22–24	25– 40
9.75	161	12–16	17–18	19–20	21–22	23– 54
10.25	123	11–15	16–17	18–19	20–22	23– 30
10.75	133	10–15	16–17	18–19	20–22	23– 38
11.25	142	11–14	15–16	17–18	19–21	22– 27
11.75	148	10–14	15–16	17–18	19–21	22– 33
12.25	179	10–13	14–15	16–17	18–19	20– 30
12.75	163	9–13	14–15	16–17	18–19	20– 29
13.50	281	8–12	13–14	15–16	17–18	19– 30
14.50	172	8–12	13–14	15–16	17–18	19– 24
15.50	75	7–12	13	14–15	16–17	18– 27

TABLE II.—YOUNG'S SHORTEST TRIALS FOR FAILURES.

Age	No.	I	II	III	IV	V
4.25	10	29–49	53–60	65–68	72–75	118
4.75	16	28–35	42–45	50–61	78–92	105–119
5.25	18	26–28	38–41	45–50	56–61	68–202
5.75	14	26–27	36–39	49–50	54–69	73–110
6.25	23	24–29	30–34	34–37	41–45	48–103
6.75	22	22–27	29–31	33–38	40–57	58–102
7.25	18	20–25	25–30	32–34	36–40	41– 53
7.75	16	16–20	25–27	30–34	35–38	49–131
8.25	10	18–21	22–23	27–28	29–30	37– 40
8.75	6	23–24	32	36	51	52
9.25	5	21	22	22	25	25
9.75	3	17		22	23	
10.25	3	20		23		43
10.75	2	19		32		
11.25	1	21				
11.75	1	19				
12.25	1	20				
12.75	1	28				
13.50	1	16				
14.50	1	13				
15.50	3	13		20		43

TABLE III.—SUMMARY OF CASES REPORTED.

Age	Case No.	Diagnosis	Rating	F. B. Time
2.25	4	N.	3	501
2.75	3	N.	4	124
3.25	14	N.	3	183
3.75	7	N.	3.3.3	59
3.75	10	N.	3	345
4.25	16	N.	3.3.3	276
4.25	13	N.	3	44
4.25	23	N.	3.2	60
4.25	24	D.	2.4	94
4.25	17	N.	3.3.3	108
4.25	11	N.	3	420
4.25	19	N.	3.3	50
4.75	22	N.	3.3.1	263
4.75	18	N.	3.3	48
4.75	25	D.	2.3	111
4.75	20	D.	3.2	89
5.25	21	M. G. I.	1.4	41
5.25	9	N.	3	105
5.75	8	N.	3	88
5.75	12	M. G. I.	1.4	42
6.25	6	N.	3.1	63
6.25	5	D.	2.3	75
10.75	2	L. G. I.	1.3	59
12.25	15	I. I.	1.2	436

N.=Normal. D.=Doubtful. L. G. I.=Low Grade Imbecile. I. I.=Idio-imbecile. M. G. I.=Middle Grade Imbecile.

TABLE IV.—DISTRIBUTION ACCORDING TO DIAGNOSIS. CLINIC CASES.

	All		Under 5		Over 5	
	Number	Per cent	Number	Per cent	Number	Per cent
Normal.....	18	13.1	16	38.1	2	2.1
Deferred.....	19	13.9	11	26.2	8	8.5
H. G. I.....	4	2.9	2	4.8	2	2.1
M. G. I.....	11	8.0			11	11.6
L. G. I.....	24	17.6	5	11.9	19	20.0
I. I.....	51	37.8	6	14.2	45	47.3
S. I.....	8	5.8	2	4.8	6	6.4
Idiot.....	2	1.5			2	2.1

TABLE V.—TIME TYPES OF FAILURE.

Diagnosis	Complete	Under 60 Sec.	Over 180 Sec.
Clinic Cases:			
Normal.....	1	5	3
Deferred.....	7	2	1
H. G. I.....	1		1
M. G. I.....		2	2
L. G. I.....	10		2
L. I.....	23	4	6
Idiot.....	2		
Young's. No Diagnosis.....	1	92	11

the ages of four and eight. In the examination of 3037 subjects Young found 188 failures, or 6.2 per cent. The difference between this and the 10 per cent of the Clinic cases is due in part to the fact that those who come to the Clinic are already selected or suspected of deficiency, but also in part to the fact that the age groups are not at all parallel. Young's failures under five years of age are only .8 per cent of the total number examined, while the Clinic failures under five years of age are 3 per cent of the total number examined. Of all the failures available the mode comes at 4.75 years, the median at 6.75. However, Young had more under four years old, 26 per cent are under five years of age and 74 per cent under eight years.

Of the 19 clinic cases in which the diagnosis was deferred, which means that these cases are at least doubtful, 8 were over five years of age. The experience of the Clinic is that the tendency is for the diagnosis to go down rather than up in the cases of deferred diagnosis, so that the probability is that at least 75 per cent of these 19 cases are feebleminded, especially those over five years of age.

As table IV shows, 69.1 per cent of the Clinic failures are over five years of age, 13.1 per cent are definitely normal, 73 per cent are definitely feebleminded, and 13.9 per cent doubtful, making a probability of 86.9 per cent feebleminded. Of the feebleminded 44.5 per cent are lower than low grade imbecile, and 28 per cent are in the imbecile group. There is also a probability of 27 per cent normal. Of these 64.3 per cent are under five years of age. Of the 73 per cent definitely feebleminded 85 per cent are *over* five years of age. Of the 86.9 per cent probably feebleminded 78 per cent are over five years of age. Of the 16 per cent definitely normal 70 per cent are under five years of age. Of the 95 subjects over five years of age who failed, 89.5 per cent are definitely feebleminded and there is a probability of 97.9 per cent. The number of cases is small but the indication of the tendency is supported by the study of the cases which follow. It is very likely that 98 per cent of those over five years of age, who are brought to the Clinic already under suspicion, who fail with the formboard, are feebleminded, and that 89 per cent are definitely so. However, it must be remembered that these are selected cases, already suspected of feeblemindedness. Yet the probability is that the examination of a larger number of apparently normal children over five years of age would support this to the extent of making the probability greater.

A treatment of the time results of these failures at the Psychological Clinic is impossible, as in many cases the record indicates no more than failure. Table V shows the approximate number of complete failures, those who failed under one minute, and those who failed after working more than three minutes. Of course all of the

137 cases could not be used in this classification. Only those where there is good evidence of time record and of complete failure were used. However, the tendencies are evident from this incomplete table. Of the 137 cases (so far as can be seen) only 15 persisted more than three minutes on the first trial; only 13 worked less than a minute and quit; while 51 failed more or less completely, making it seem not worth while to record the time. Of those considered complete failures 84 per cent are definitely in the feebleminded class with a probability of 98 per cent. Of the failures in one minute or less more than 50 per cent are probably feebleminded. In the three minute class 27 per cent are probably normal, and 20 per cent definitely so.

The futility of comparisons based upon the time records of failures with the formboard is made obvious by a consideration of the difficulties encountered by the different subjects. If the formboard presented the same difficulties for each, the time would mean more as a measure of general ability. As it is, the time is a measure only of formboard ability. Young takes the shortest record of three trials as the index of formboard ability. This is challenged. It is not an index of the child's resourcefulness and intelligence, but is a composite result produced by his intelligence and the training received in his other trials. If all conditions could be equalized for every trial for every subject; if the attitude of every subject were the same, allowing for differences in ability to attend, etc.; if the attitude of the examiner were the same in every trial for every subject, then the shortest trial might be the index. But it seems as if these factors are equalized most nearly in the first trial and a careful study of that trial is most important.

In every examination the subject was told to see how *quickly* he could put the blocks back. The suggestion to hurry or do the test fast does not have much, if any, effect upon children under six years of age. Their movements are very deliberate and slow and there is no indication that the young child has the concepts of time and speed. With most children it is simply a matter of understanding the terms and the idea suggested. They are told many times a day to hurry, but they do not hurry. In the child of two to three years of age there is absolutely no response to the command to hurry. There may be some response from the child from three to six years of age, if the command is repeated urgently, but the response will be a quickening of the movements where the gain is of no advantage. Case 1, at the age of three years and six months, after much training with the formboard, when urged to hurry, will make quick movements of the hands after the block is selected and near the recess by slapping it down quickly, but she loses just as much time as ever in

picking up the blocks and finding the recesses. Her speed has improved through practice, but not because of any understanding of what it means to do the test fast. The older child gets the concept very slowly, especially before he goes to school where he has experiences of tardiness and its consequences, urging to be prompt in response to signals, urging to read faster, to hurry up and down stairs with others who are hurrying, hastening in games, and the rush home at meal time under the spell of the ravenous appetite of early school days. In the case of a few children of six or seven years of age the only response to the suggestion to hurry was the making of swift movements similar to those described above. This is the first noticeable element of behavior in line with the developing concept of speed; swift movements after there is no longer need for thought, studied imageability, etc., but no speed in the analytic process. Children who do try to hurry make slower records. Often the number of errors is not due to lack of ability to perceive form, but to blurred and incomplete perception due to rapid work.

To the second part of the first instructions, "Use both hands if you want to," there is no response of any consequence until from eight to ten years of age. All of the younger subjects work with the preferred hand, at best simply making the other hand assist in removing wrongly placed blocks or in passing blocks to the other hand. It can be quite definitely concluded that if a child of six, seven, or eight, uses both hands in selecting and placing the blocks, he has good initiative, originality, and planfulness, and that in this case the formboard aids in selecting an individual of more than average ability.

Two general classes of failures are found, the normal and the feebleminded, but this classification can hardly be based upon the fact of failure or success alone. As has already been said, the child over five years of age who fails with the formboard is very likely to be feebleminded, the child under five who fails may be feebleminded, but the failure alone does not prove that, for more children between the ages of three and five succeed than fail. The failure may be indicative of the lack of development of an ability or a complex of abilities. In one child we will have one who lacks and in another one in whom the ability has not yet developed, and each may show the same symptoms, so far as formboard performance is concerned. If thinking and mental ability are dependent upon the functioning of the nervous system and particularly the brain centers and medullated fibres, it is possible that in a young child some of these centers are not yet developed enough to function adequately or the fibres are not yet medullated because of lack of the kind of experience necessary to develop them. Thus the dis-

tinction arises as to whether a subject fails because of a congenital defect or because his experience has been such that his intellect is too small. His intelligence is affected by both.

No failures are due to lack of vitality, health, control, coördination, or dexterity, although performance is qualitatively affected by all. If a child is poor enough in any of these abilities to fail he would not be submitted to any sort of test. Most failures are due to some sort of failure of attention and particularly distribution of attention and persistent concentration of attention. In the cases reported in this investigation these two kinds of failures include three-fifths of all. There is a vast difference between concentrated persistence and simple persistence. Case 15, the idio-imbecile, is a fine example of this. She persisted but could not concentrate. This is so closely associated with failure due to lack of analytic concentration of attention that the two cannot be separated. She could not give enough attention to analyze the task. The least distraction threw her off. She recognized the recesses corresponding to the blocks and associated them very well, but the least impulse was sufficient to induce her to take out one already correctly placed and try it elsewhere. Yet she stuck to it.

Failure, therefore, means inability to give proper attention. This raises the old question,—what is attention? It is a state of consciousness in which some one object, or thought, occupies the center of consciousness to the relative exclusion of all other objects or thoughts. It is the focalization of consciousness in which experience is used in judging. If experience is meager, judgment is poor, and the performance correspondingly poor. Hence distractibility is a prime cause of failure of attention; but it is not the only cause. The stolid, dull, lethargic child with low vitality, without vivacity, not alert enough to have his attention caught by distractions, will also fail because of inability to attend. Here it may be said that he cannot give proper attention to the task in hand for exactly the same reason that he cannot be distracted. He cannot attend to anything. There may be several reasons for this. First, he may be feeble-minded; the cells of the cortex may be undeveloped, the association pathways may not be made clear, or there may be lesions in the cortex, in the inner nuclei, or among the fibres leading to the cortex. Secondly, the subject may be so young that the cells of the cortex are relatively undeveloped and the association pathways are not yet established. By the time this has come about there is sufficient ability in coördination to succeed with the task. This makes possible a very definite line of distinction between the two general classes of failures in which the causes are apparently the same. The feeble-minded child is very much like the very young normal child.

In many cases failure seems due to lack of imageability or understanding. However, if there is persistence enough, many children will succeed with poor imageability. Persistence in the trial and error method will bring success in spite of poor imageability. This persistence is indicative of some distribution of attention. It is reasonable that one may fail to understand the task because there is very poor form perception or imageability. There is a reciprocal relation between the abilities here. Although imagination is the most general and comprehensive of the powers of the mind, yet it is true that with poor power of attention, in any respect, there is poor imagination, and where there is poor imagination and distribution of attention, analytic and persistent concentration of attention are not possible. Distribution of attention may be defined as the ability to see the possibilities in a given situation; analytic concentration of attention may also be defined as the ability to select out the important and significant details of the situation. Therefore lack of distribution of attention is much more likely to produce failure, than lack of analytic concentration of attention or lack of imageability or associability.

It is apparent, therefore, that failure with the formboard is primarily a failure in some way of attention. From the standpoint of attention there are three things most necessary for the satisfactory and ready completion of this test: distribution of attention, persistent concentration of attention, and analytic concentration of attention. If the range of attention is too limited, no one can perform this test. That is, if attention is too fixed there is a tendency to obsession, the task is not grasped and the possibilities are not seen. On the other hand, if distribution of attention goes so far as to make it too widely dispersed, the difficulty is quite similar and the task cannot be completed. The highly distractible subject is an illustration of this. There is a middle ground, where there is a distribution of the attention sufficient to cover or grasp the possibilities, and yet where there is enough concentration upon the immediate part to complete it as an element of the whole. These things are observed in the behavior of the very young child. Both difficulties are likely to occur, the child may be easily attracted to other things and the next minute may be under the spell of his efforts to place a given block in the wrong recess. Where this is the case we have an emphasis on the fact that in the education of the child he must be held to any educational task by repeated encouragement and command, up to the point of fatigue or distraction due to misunderstanding of the command.

A small range of attention may be due to lack of development, to congenital deficiency, or to injury. The range may be so small that

comparison of forms, or of forms with recesses is impossible. This comparison marks the use of a more intelligent process in the performance of the formboard test. The child goes beyond the trial and error method, beyond simple recognition, to a simple reasoning process. But it follows immediately upon attentive observation of two or more objects with the question in mind as to which two are most alike. This, we note, depends upon range and distribution of attention and is the thing which so many young and deficient children lack; hence the dependence upon trial and error, or the giving up to failure. In every case where there is such comparison and consequent judgment there is good distribution of attention and analytic concentration of attention. Pillsbury[2] calls this 'judgment of evaluation or association.' This judgment of evaluation or association without actual perception marks a still higher process and hence signifies greater ability. If the child selects a block and says to himself, "Oh yes, I know where this goes, I remember seeing the right recess," he is making a judgment of evaluation on association. As judgment, then, is dependent upon the nature of attention, so inference, in its simplest form, may be said to be an association dependent upon the nature of attention. Inference is simple judgment, judgment is the selection of the essential element of a given situation with a comprehension of some of the possibilities. But such a consciousness of the situation and the selection are dependent upon sensation, and the consciousness of the sensation is dependent upon attention. In the performance of the formboard test there must be some consciousness of the situation and, of course, there is some selection, and these things depend upon the ability to give proper attention. This brings us to the point that while attention is most important in the performance of the test, attention itself is dependent upon a complex of the other abilities, the lack of any one of which would *not* bring about failure. Imageability and associability determine the fixation of attention, attention then determines what course specific imagination shall take and hence aids in determining the understanding of the task. Specific imagination in turn depends upon memory, its trainability and retentiveness and the readiness of recall, in short upon the clarity of the mental image. It becomes apparent at once that "the conditions of attention are as widespread as the conditions of consciousness."[2]

It has already been said that the essence of attention is the increase of the clearness of one idea or group of ideas at the expense of others. If all forms in the formboard are equally clear, attention is too dispersed; if none are analyzed, or if only one is observed, there is no clearness of the mental image and hence no clear idea dominates consciousness. It is impossible to measure the participation of all of the mental processes in determining a state of attention,

but much depends upon association in perception. Clear perception is fundamental. Some apperceptional background is also fundamental, but this is dependent, in the first place, upon former clear perceptions and these upon certain motor adaptations and coördinations, which come about in response to some stimulus. The value of the formboard as a test of attention is that it gets down to the fundamentals of attention, for in practically every case the stimulus of the sharply defined blocks and recesses is so strong that there is adaptation of the sense organs and correlated movements of the organism and its parts. Only if there be defect in sense organs, or motor inability, extreme distractibility or stubbornness, in the otherwise normal child, will there be failure to respond. After the response, attention may be measured roughly by the accomplishment and the amount of stimulus necessary for distraction. If distraction comes early, there is little persistence of attention. Fluctuation of attention depends upon the duration of acts of attention, and this is largely due to the fatigue of the cortical cells.

Again, the response that the examiner gets from the subject depends upon two sets of conditions. These two include all of what has already been said. This classification aids in keeping clear the two sides of the question of attention. Attention depends upon objective and subjective conditions; upon the nature of the task and its physical background or setting, and upon the nature of the mind of the subject at the time of presentation. Under objective conditions we have the summation effect of successive stimuli, those brought by the test itself and by the environment. This covers the matter of repetition of instructions, urging, even starting the performance, and all possible distractions. Under subjective conditions we include the mental state of the subject when the task is presented to him, and this will be determined by the nature of the objective conditions and by his past experience. The kind of attention given will depend more upon the latter than upon the former. In the instructions of the examiner, "I am going to take all these blocks out and put them up here——," the subject has an opportunity to picture himself doing it. A child with experience with blocks will do better because he has had some ideas which were similar to the one aroused. The mood of the child at the moment of the test, his attitude toward his world, his health tone, and his immediately preceding experience are determining factors in the subjective condition. The whole attitude toward the present task will be a complex determined by his apperceptional background. To some children it is an opportunity to play a game, to some it means a command to do hard work which they will be compelled to do. The child with a lack of manual and digital experience will be sadly handicapped. We are inclined to say that the

performance depends upon the interest the child takes in the task, but we are only saying again what has already been said. Interest is only the objective way of looking at the conditions of attention.

This brings us to the point that attention goes back fundamentally to the element of consciousness, sensation. Clarity of perception is due to sense acuity and imageability, the initial ability to have images. The stimulus which gets attention must be relatively intense, the conditions of the subject must be such that the proper motor adaptations and coördinations are made, and the apperceptional background must contribute toward making the sensation pleasurable. This brings out the fact of the participation of mental processes other than sensation in perception. Perception is not the mere entrance of a group of sensations, but an arousal of old experience by a few newly entering sensations. The perception of the thing to be done is then the result of present sensation as interpreted in accord with past experience. Voluntary action is a problem of attention. This produces a syllogism: action is dependent upon sensation; attention controls the entrance and course of sensation and its consequent ideas; therefore attention controls action.

The child who cries, who is shy, nervous, stubborn, excited or frightened, cannot give proper attention, for attention is very poor when feeling and emotion are strong. Most attention involves strain, and emotion involves attention to that which distracts from the task in hand. Emotion or feeling is attention to sensation. Emotion is not a matter of inattention but of strained attention, hence the futility of attempting to secure the solution of a problem, the making of a comparison, or the passing of judgment, during the stress of emotion.

The above brings us to the conclusion that "attention has an anatomical basis and that as a starting point for a nervous explanation of attention we must accept the hypothesis of psychophysical parallelism."[3] With this in mind it appears, first, that the conditions of a state of attention at any given moment depend most largely upon apperceptional urge; and secondly, that successful performance of the formboard test depends upon knowledge of space relations acquired by the child through trial and error or through training.

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2. PILLSBURY, W. B. Attention. New York: The Macmillan Co., 1908. Pp. 173–174.

3. *Ibid.* Pp. 234.

For further reference to reports on investigations with the formboard, see H. H. YOUNG, The Witmer Formboard, THE PSYCHOL. CLINIC, 1916, 10, Pp. 110–111.